REMARKS

This is intended as a full and complete response to the Final Office Action dated February 19, 2010 having a shortened statutory period for response set to expire on August 19, 2010 with a petition of a three month extension. Claims 1, 4, 6, 9, 10, 12, 13-16, 23, 25, 31, 32, 34, 35, 37, 47, 49 and 51 have been amended and new claims 54-67 have been added to more clearly recite various aspects of the invention. Support for the amendments and new claims may be found throughout the specification, including Figure 1A, page 1, line 21 – page 2, line 3, page 6, lines 15-16, page 10, lines 21-25, page 11, lines 12-14, page 17, line 26 – page 18, line 4, page 18, lines 16-26, page 19, lines 13-15, page 25, lines 18-20, page 37, lines 7-9, page 45, line 11 – page 47, line 2, page 50, lines 1-12 and originally filed claims 13 and 29. Claim 29 has been canceled without prejudice. Applicants believe no new matter has been introduced by the amendments and the new claims presented herein. The amendments and new claims have been made to put the claims in condition for allowance or in better condition for an appeal. Applicants reserve the right to subsequently take up prosecution of the claims as originally filed in this application in a continuation, a continuation-in-part and/or a divisional application. Please reconsider the claims pending in the application for reasons discussed below.

Applicants would like to thank the Examiner for removing the rejection under 35 U.S.C. 112 in the previous office action in view of the amendments presented in the previous response.

Claims 1-3, 6, 9-15, 18, 19, 22, 25, 27-30 and 41 stand rejected under 35 U.S.C 102(a) as being anticipated by U.S. Patent No. 6,691,038 ("Zajac"). Claim 29 has been canceled without prejudice, thereby rendering the rejection with respect to that claim moot. Zajac is generally directed to an active control system for a towed seismic streamer array that enables relative positional control of towed **seismic streamers**. Claims 1 and 25 have been amended to now include "a plurality of **seismic sources**," "estimating positions of the **seismic sources**" and "determining optimum tracks for the **seismic sources**." Support for the amendments may be found throughout the specification, including page 5, lines 3-4, page 6, lines 9-14, page 14, line 25 – page 15,

line 28, page 15, lines 12-17, page 17, lines 11-12 and #16 in Figure 1A. Zajac does not teach "estimating positions of the **seismic sources**" and "determining optimum tracks for the **seismic sources**."

The Examiner takes the position that Zajac teaches estimating positions of the sources and receivers using the navigation data, the operating states and the environmental data and determining optimum tracks for the sources in column 5, lines 5-7 and column 8 lines 7-9 and 29-31. (See Office Action, Page 6). In addition to these portions of Zajac, column 7, lines 13-37 of Zajac is provided below to clarify what Zajac teaches about estimating positions of the sources and receivers.

> In another aspect of the invention the apparatus further comprises a master controller which **compares the positions of the streamers versus time and the array geometry versus time to a desired streamer position and array geometry versus time and issues positioning commands to the ASPDs to maintain the desired streamer position and array geometry versus time**. In another aspect of the invention the apparatus further comprises a master controller that **factors in environmental factors into the positioning commands to compensate for environmental influences on the positioning of the streamers and the array geometry**.
> (Zajac, column 5, lines 4-14, Emphasis Added).

> Turning now to FIG. 2, in a preferred embodiment of the present invention, the control system for the ASPD 18 may be distributed between a master controller 26 located remotely on the towing vessel (or at any other location on land, sea or satellite) and a group of one or more separate controllers 18 built into one or more ASPDs 18, which is positioned on streamer 12 within the seismic array. The master controller 26 may be located remotely and communicate via satellite or other communication means as shown in FIG. 6. **The master controller receives data representing individual position of at least one point on the array, but preferably one or more points on each streamer element**. These streamer positions from individual ASPDs 18, are processed, compared to the desired positions and commands are transmitted to the individual ASPD 18. The link between the active controllers on ASPD 18 and the main controller 26 can be accomplished by any suitable electronic cable, such as coaxial or fiber-optic cable attached to the towed array, via point to point communications or RF communications facilitated by a transceiver attached to the towed array. As shown in FIG. 6, **the tracking information from a plurality of points on individual streamers comprising the seismic array can be obtained and transmitted to the master controller 26 via satellite or radio frequency or any other means of communication**.

(Zajac, column 7, lines 13-37, Emphasis Added).

The array, streamer and individual ASPD three-component (x, y, z) position data with respect to time is stored along with real time environmental data. Environmental data is received via cable or radio from sensors deployed from the vessel or the array. **The stored position and environmental data is stored as legacy data in the legacy data storage 22**. Optimal path data, is generated by Optimal path processor 24, which may be generated by a neural network or some other methodology such as human input or mathematical formulae, is input to master controller 26. **Optimal path data may be provided as a desired seismic acquisition path during primary seismic data acquisition or during in fill shooting. Optimal path data steering is preferably divided between an optimal path for the tow vessel 10 and an optimal path for the towed array. During seismic data acquisition utilizing an optimal path 24, vessel, array, array element and ASPD positions are sensed** along with environmental data are transmitted to and received by the data acquisition unit 21. The data acquisition unit 21 stores these inputs with respect to time as legacy data in the legacy data storage 22. The data acquisition unit 21 also passes the array and environmental tracking data to the master controller 26. **The maneuverability of the particular cable, ASPD and vessel under the particular sensed environmental conditions are also factored into the active positioning commands**. For example, a cable that becomes stiffer in colder water or more buoyant in higher salinity receives an augmented steering command depending on the sensed environmental data. Master controller 26 compares the current vessel and array position data with the desired position or optimal vessel and array path position. **The master controller 26 then determines, in light of the current environmental conditions and the maneuverability of the vessel, ASPDs and towed streamers comprising the array, the timing and magnitude of positioning commands to be sent to the ASPDs on the array.** The positioning commands are formatted and transmitted by active position commander 28 over link 30. Link 30 may be hardwired or wireless via satellite, laser or radio link.
(Zajac, column 8, lines 1-38, Emphasis Added).

As shown above, nothing in these sections mentions seismic sources, let alone estimating the positions of **seismic sources** or determining optimum tracks for the **seismic sources**, as recited in claims 1 and 25. In contrast, Zajac tracks the position and determines the optimal path of **the array, streamer and individual ASPDs**.

Additionally, claims 1 and 25 have been amended to now include "wherein the at least two of the spread control elements comprise a seismic source control element and

a streamer control element." Support for the amendments may be found throughout the specification, including page 6, lines 15-16. Claims 1 and 25 calculate drive commands for a seismic source control element and a streamer control element. The Examiner takes the position that Zajac teaches calculating drive commands for at least two spread control elements in column 5, lines 8-10. As shown above, Zajac does not mention drive commands for **seismic source control elements**. In contrast, Zajac sends positioning commands to ASPDs, which are not the same as seismic source control elements.

Further, the Examiner takes the position that Zajac teaches operating states from sensors because Zajac teaches monitoring the operating status of a streamer. In particular, the Examiner suggests that it is well known in the art that monitoring the operating status of a streamer includes monitoring the status of the streamer components, which includes sources, receivers and spread control elements. (See Office Action, page 2, paragraph 3). The Examiner also takes the position that Zajac teaches determining maneuverability of the spread control elements and the positions of the spread control elements, both of which are measurements from sensors associated with the spread control elements and are therefore operating states. (See Office Action, page 2, paragraph 3). However, Zajac's monitoring status is not the same as the operating states, as recited in claims 1 and 25. New claim 65 has been added to further clarify the meaning of "operating states." In particular, new claim 65 describes the sensors related to the operating states as measuring tension, water flow rate, vertical inclination, body orientation, acceleration or combinations thereof associated with the spread control elements. Support for the amendment may be found throughout the specification, including page 19, lines 13-15 and was previously recited in claim 10. Zajac does not teach operating states that include these characteristics.

In trying to show that Zajac teaches monitoring the operating states of a streamer, the Examiner points to column 8, lines 23-25 and column 7, lines 47-49 as teaching the maneuverability and the positions of the spread control elements. Column 8, lines 23-25 is provided above. Column 7, lines 47-49 are provided below along with additional relevant sections of Zajac for the Examiner's convenience.

> The active tracking and positioning system of the present invention provides a method and apparatus that enables relative positional control of any number of towed seismic streamers. The present invention controls streamer positions horizontally and vertically using active control units positioned on each streamer within the seismic array. **The three component (x, y, z) position of each streamer element**, relative to the vessel, relative to each other and relative Earth coordinate latitude and longitude **is controlled, tracked and stored** with respect to time during each seismic data acquisition run. This stored data is referred to as legacy data. **Environmental factors** (wind speed, currents, temperature, salinity, etc), **and maneuverability data** for the streamers and geometry of the towed array (cable diameter, array type, deployed configuration, vessel type, device type, etc.) for the seismic data acquisition run **are also sensed** with respect to time and stored as legacy data. The acquisition of legacy data enables repetition of seismic data acquisition runs.
> (Zajac, column 2, lines 50 – 67, Emphasis Added).

> Turning now to FIG. 2, the master controller 26 of the present invention **receives the three component position of each active controller** in the array, as shown in FIG. 6. Thus, the present invention enables tracking with respect to time, of each individual ASPD and the streamer cable with which the ASPD is associated. Each active controller element is also equipped with a receiver for receipt of commands generated and formatted by the master control 26 and transmitted by active position commander 28. The commands are sent to the ASPDs 18, to instruct each of the ASPDs regarding commands for changing the position of each individual streamer to maintain desired array geometry and overall position. The positioning commands can be absolute commands or represent changes in position from the last command to the particular ASPD. The flexibility of the individual ASPD 18 enables **precise positioning of each individual ASPD** and associated streamer within the towed streamer array. The present invention enables control of the horizontal, vertical and depth position of the entire array geometry comprising the individual streamers, individual streamers and attached ASPDs, with respect to time.
> (Zajac, column 7, lines 13 – 65, Emphasis Added).

As shown above, Zajac does not teach operating states from sensors that measure **tension, water flow rate, vertical inclination, body orientation, acceleration** or combinations thereof associated with the spread control elements, as recited in claim 65.

With regard to claim 13, the Examiner takes the position that Zajac teaches survey design data that includes source and receiver positions and collected input data that includes an operator input. (See office action, page 8, paragraph 11). Claim 13 has been amended such that the "source and receiver position" and the "collected input data" have been removed from the claim. As such, claim 13 now recites "wherein the survey design data includes one or more data types of area, depth, area rotation or shooting orientation, line coordinates, required coverage, local constraints, optimizing factors and historical data." Support for the amendment may be found throughout the specification, including page 25, lines 18-20. Accordingly, since claim 13 no longer recites source and receiver positions and collected input data, Zajac does not teach all the limitations recited in claim 13.

New claim 54 has been added to further clarify the collected input data that was previously recited in claim 13. New claim 54 defines the collected input data as including "one or more data types of pre-survey, present survey, near-real time, real-time survey, and simulated survey." Support for new claim 54 may be found throughout the specification, including page 11, lines 12-14 and was previously recited in claim 13. As mentioned above with regard to claim 13, the Examiner takes the position that Zajac teaches collected input data that includes an operator input. (See office action, page 8, paragraph 11). The "operator input" limitation has been removed from the "collected input data" limitation. As such, Zajac does not teach all of the limitations recited in new claim 54.

New claim 55 has been added to further clarify the error states recited in claim 6. Support for new claim 55 may be found throughout the specification, including page 37, lines 7-9.

For these reasons, claims 1, 13 and 25 are patentable over Zajac. Claims 2-3, 6, 9, 11-12, 14-15, 18, 19, 22, 27-28, 30, 41 and 54-55 are also patentable over Zajac, since they depend from claims 1 and 25, respectively. Withdrawal of the rejection is respectfully requested.

Claims 4, 5, 7, 16 and 53 stand rejected under 35 U.S.C. § 103(a) as being unpatentable over Zajac in view of US Patent No. 6,618,321 ("Brunet"). Claim 8 stands rejected under 35 U.S.C. § 103(a) as being unpatentable over Zajac in view of US

Patent No. 5,448,233 ("Saban"). Claims 17 and 23 stand rejected under 35 U.S.C. § 103(a) as being unpatentable over Zajac in view of US Patent No. 7,446,706 ("Riley"). Claim 20 stands rejected under 35 U.S.C. § 103(a) as being unpatentable over Zajac in view of Gikas et al, "Reliability analysis in dynamic systems: Implications for positioning marine seismic networks", *Geophysics*, Vol. 64, No. 4, July-August 1999, pgs. 1014-1022 ("Gikas"). Claim 21 stands rejected under 35 U.S.C. § 103(a) as being unpatentable over Zajac in view of Armstrong et al, "The best parameter subset using the Chebychev curve fitting criterion", *Mathematical Programming*, Vol. 27, No. 1, September 1983, pgs. 64-74 ("Armstrong"). Neither Zajac nor Brunet nor Saban nor Riley nor Gikas nor Armstrong, alone or in combination, teaches or discloses operating states; estimating positions of the seismic sources; determining optimum tracks for the seismic sources; or wherein the at least two of the spread control elements comprise a seismic source control element and a streamer control element, as recited in claim 1. Since claims 4, 5, 7, 8, 16-17, 20, 21, 23 and 53 depend from claim 1 and since neither Zajac nor Brunet nor Saban nor Riley nor Gikas nor Armstrong, alone or in combination, teaches, discloses or suggests all the limitations of claim 1, claims 4, 5, 7, 8, 16-17, 20, 21, 23 and 53 are therefore also patentable over Zajac, Brunet, Saban, Riley, Gikas and Armstrong. Withdrawal of the rejection is respectfully requested.

Claims 26 and 31 stand rejected under 35 U.S.C. § 103(a) as being unpatentable over Zajac in view of US Patent No. 6,292,436 ("Rau") and US Patent No. 6,681,710 ("Semb"), respectively. Neither Zajac nor Rau nor Semb, alone or in combination, teaches or discloses operating states; estimating positions of the seismic sources; determining optimum tracks for the seismic sources; or wherein the at least two of the spread control elements comprise a seismic source control element and a streamer control element, as recited in claim 25. Since claims 26 and 31 depend from claim 25 and since neither Zajac nor Rau nor Semb, alone or in combination, teaches, discloses or suggests all the limitations of claim 25, claims 26 and 31 are therefore also patentable over Zajac, Rau and Semb. Withdrawal of the rejection is respectfully requested.

Claims 32-37 stand rejected under 35 U.S.C. § 103(a) as being unpatentable over Zajac in view of US Patent No. 6,088,298 ("Onat"). Claims 32 and 37 have been

amended to now include estimating the positions of sources based on data received from one or more reference points on a seismic survey spread with respect to the earth. Support for the amendments may be found throughout the specification, including page 18, lines 18-26. Neither Zajac nor Onat teaches this newly added limitation.

The Examiner takes the position that Zajac teaches estimating positions of sources in column 5, lines 5-7, column 7, lines 22-25 and column 8 lines 29-31. Column 5, lines 5-7, column 7, lines 22-25 and column 8 lines 29-31 have been reproduced above.

This section in Zajac does not teach estimating the positions of the sources based on data received from one or more reference points on a seismic survey spread with respect to the earth.

New claims 56-57 have been added to further clarify the locations of the references points in the seismic survey spread as being located on opposite corners of the seismic survey spread or on each corner of the seismic survey spread. Support for the new claims may be found throughout the specification, including page 17, line 26 – page 18, line 4 and Figure 1A, #50 and #58. Neither Zajac nor Onat teaches using these locations for references points.

For these reasons, claims 32 and 37 are patentable over Zajac and Onat. Claims 33-36 are also patentable over Zajac and Onat since they depend from claim 32. Withdrawal of the rejection is respectfully requested.

Claims 39, 40, 42-47, 49 and 51 stand rejected under 35 U.S.C. § 103(a) as being unpatentable over Zajac in view of US Patent No. 4,063,213 ("Itria") and US Patent No. 6,590,831 ("Bennet"). Neither Zajac nor Itria nor Bennet, alone or in combination, teaches or discloses operating states; estimating positions of the seismic sources; determining optimum tracks for the seismic sources; or wherein the at least two of the spread control elements comprise a seismic source control element and a streamer control element, as recited in claim 25. Since claims 39, 40 and 42-44 depend from claim 25 and since neither Zajac nor Itria nor Bennet, alone or in combination, teaches, discloses or suggests all the limitations of claim 25, claims 39, 40 and 42-44 are therefore also patentable over Zajac, Itria and Bennet.

With regard to claims 45 and 49, the Examiner takes the position that Zajac teaches controlling vessel control elements and streamer control elements, while Itria teaches controlling source control elements, and the combination renders claims 45 and 49 obvious. (See Office Action, page 5, paragraph 9). However, Itria is not a sufficient prior art reference to render these claims prima facie obvious because the proposed modification would render the prior art invention being modified unsatisfactory for its intended purpose. (See MPEP 2143.01; *In re Gordon*, 733 F.2d 900 (Fed. Cir. 1984)). Here, the Examiner's proposed modification of controlling the vessel and streamer control elements using Zajac, and controlling the source control elements using Itria, would significantly change the seismic surveying operation disclosed in Zajac. Zajac, among others, coordinates the positioning of the vessel and the positioning of its streamers to provide for more flexible positioning for in fill shooting. (See Zajac, column 2, lines 50-67 and column 4, lines 36-48). Itria, on the other hand, uses its source control elements to maintain a constant, precise and predetermined distance between its sources and its streamers. (See Itria, column 4, lines 13-19). The Examiner's proposal of combining controlling the vessel and streamer control elements in Zajac with controlling the source control elements in Itria would significantly change the principle of operation **flexible positioning** taught in Zajac, since Itria requires its source and streamer to maintain a predetermined distance between each other.

Furthermore, Zajac, among others, uses legacy data to repeat seismic data acquisition runs. As such, the Examiner's suggestion of combining Zajac and Itria would limit Zajac's ability to repeat seismic data acquisition runs using stored legacy data because Itria maintains a predetermined distance between its sources and streamers, which may conflict with seismic data acquisition runs stored in the legacy data. Therefore, Itria is not a sufficient prior art reference to render these claims prima facie obvious and cannot be used in combination with Zajac.

New claim 63 has been added to further clarify how the claimed invention is used for reoccupying coordinates from a prior survey to achieve a 4D time-lapsed seismic survey. Support for the new claim may be found throughout the specification, including page 1, line 21 to page 2, line 3 and page 50, lines 1-12.

Claim 47 has been amended to now include "estimating one or more positions of the spread control elements based on data received from one or more acoustic positioning receivers and one or more reference points on the seismic survey spread with respect to the earth" and "controlling the seismic survey spread by coordinating the positioning of the vessel control elements and the source control elements based on the estimated positions." Claim 51 has been amended to now include "estimating one or more positions of the first vessel control element and the second vessel control element based on data received from one or more acoustic positioning receivers and one or more reference points on the seismic survey spread with respect to the earth" and "controlling the seismic survey spread by coordinating the positioning of the first and second vessel control elements based on the estimated positions." New claims 62 and 64 have been added to further clarify claims 45 and 49. Support for the amendments and the new claims may be found throughout the specification, including page 18, lines 18-26. Neither Zajac nor Itria nor Bennet, alone or in combination, teaches or discloses these newly added limitations.

For these reasons, claims 45, 47, 49 and 51 are therefore patentable over Zajac, Itria and Bennet. Claims 46 is also patentable over Zajac, Itria and Bennet since it depends from claim 45. Withdrawal of the rejection is respectfully requested.

Claim 51 also stands rejected under 35 U.S.C. § 103(a) as being unpatentable over Zajac in view of US Patent No. 6,590,831 ("Bennet"). As mentioned above, claim 51 has been amended to now include "estimating one or more positions of the first vessel control element and the second vessel control element based on data received from one or more acoustic positioning receivers and one or more reference points on the seismic survey spread with respect to the earth." Neither Zajac nor Bennet, alone or in combination, teaches or discloses these newly added limitations. Withdrawal of the rejection is respectfully requested.

With regard to new claims 58-61 and 66-67, Applicants submit that claims 58-61 and 66-67 recite subject matter that is neither disclosed, taught, nor otherwise suggested by the cited references, and as such, allowance of these claims is respectfully requested.

In conclusion, the references cited by the Examiner, neither alone nor in combination, teach, show, or suggest the claimed invention. Having addressed all issues set out in the office action, Applicants respectfully submit that the claims are in condition for allowance and respectfully request that the claims be allowed.

The prior art made of record is noted. However, it is believed that the secondary references are no more pertinent to the Applicants' disclosure than the primary references cited in the office action. Therefore, it is believed that a detailed discussion of the secondary references is not deemed necessary for a full and complete response to this office action.

Respectfully submitted,

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